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First in-gas laser spectroscopy with S³-LEB

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The S³-LEB (Super Separator Spectrometer-Low Energy Branch) is a low energy radioactive ion beam installation dedicated to the study of exotic nuclei, which is currently under commissioning as a part of the GANIL-SPIRAL2 facility [1]. High intensity primary beams delivered by the superconducting LINAC of SPIRAL 2 will allow increased production rates of nuclei by fusion evaporation reactions and thus will facilitate the exploration of the neutron-deficient and heavy-mass extremes of the nuclear chart. The reaction products will be separated by the recoil separator S³ and will be delivered to the LEB installation coupled to the S³ focal plane [2].

S³-LEB is a gas cell setup where the radioactive ions of interest are thermalized, neutralized and then selectively laser ionized either inside the gas cell or in a hypersonic gas jet environment created after the gas cell using a De-Laval nozzle. It is then followed by radiofrequency quadrupole ion guides, which allow efficient transmission of the ions to a Multi-Reflection Time of Flight Mass Spectrometer (MR-TOF MS) for further beam purification and detection. A decay spectroscopy station, Spectroscopy Electron Alpha in Silicon Box Counter (SEASON), will also be coupled to the LEB installation expanding its capabilities. First offline results from S³-LEB were published recently presenting the commissioning of laser systems and conditions for optimum operation of the ion guides obtained using an alkali ion source [3].

Here we present the progress in the offline commissioning of the S³-LEB setup highlighting the results obtained after coupling the gas cell to the ion guides and the first laser spectroscopy in the gas cell/jet, as well as the transport of laser ions, bunching and trapping in the MR-TOF MS. For the offline tests and in preparation of one of the day-1 experimental campaigns, a filament was heated in the gas cell for the production of stable isotopes of Erbium. A first view of the performance of the installation in preparation for S³ experiments will be given.

References:

- [1] Grand Accélérateur National d'Ions Lourds, URL: <https://www.ganil-spiral2.eu/en/>
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- [3] J. Romans et al., Atoms, 10, 21 (2022), URL : <https://doi.org/10.3390/atoms10010021>

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